

Comparative Evaluation of Four Annual MM5 Simulations

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Motivation

Several annual MM5 simulations are available:

EPA 36/12km 2001

VISTAS,WRAP 36/12km 2002

MRPO(IL,WI) 36km 2003

Others (not focus of this talk)

Motivation (cont.)

MM5 Simulations for Multiple Purposes

Regional Haze Modeling

PSD Impact Analyses (CALPUFF)

BART Analyses

Over Different Spatial Scales

1000's of km for Regional Haze

100's of km for PSD Impacts

Motivation (cont.)

Each MM5 Simulation has been evaluated, but different statistics/displays make it difficult to compare results

Decided to evaluate all simulations using common software (MAPS) and observations (TDL DS472.0)

EPA project had paid to get the evaluation software around for annual simulation (Thanks Pat)

Philosophy

Don't know how the MM5 simulations could get used.

Evaluate in as general a manner as possible.

Methodology

Evaluate Simulations

Monthly

State-by-State

RPO-by-RPO

Variables

Mixing Ratio (Bias/Error)

Precipitation (Bias/Error)

Temperature (Bias/Error)

Winds (Index of Agreement)

Currently 36km Simulations Only *Advanced Atmospheric Modeling*

Simulations (so far...)

2001 36km EPA (Alpine)

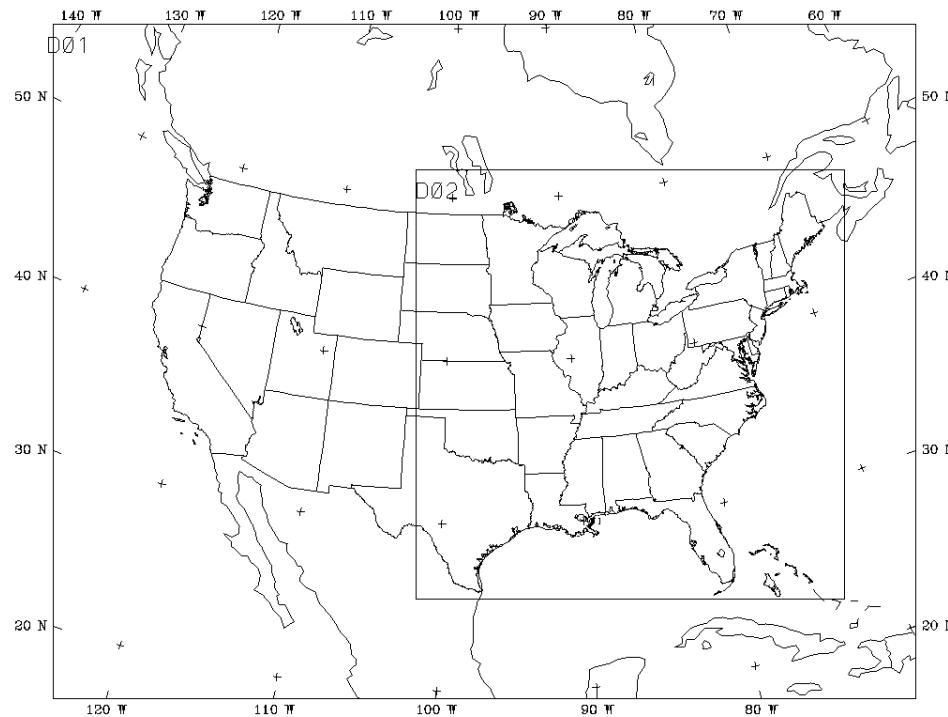
2002 36km VISTAS (BAMS)

2003 36km WRAP (WRAP/ENVIRON)

2004 36km MRPO (LADCO,WI,IL)

Horizontal Grid Structure

“RPO” Projection (165x129,40,-97,33,45)



Vertical Grid Structure

k(MM5)	sigma	press.(mb)	height(m)	depth(m)
34	0.000	10000	15674	2004
33	0.050	14500	13670	1585
32	0.100	19000	12085	1321
31	0.150	23500	10764	1139
30	0.200	28000	9625	1004
29	0.250	32500	8621	900
28	0.300	37000	7720	817
27	0.350	41500	6903	750
26	0.400	46000	6153	693
25	0.450	50500	5461	645
24	0.500	55000	4816	604
23	0.550	59500	4212	568
22	0.600	64000	3644	536
21	0.650	68500	3108	508
20	0.700	73000	2600	388
19	0.740	76600	2212	282
18	0.770	79300	1930	274
17	0.800	82000	1657	178
16	0.820	83800	1478	175
15	0.840	85600	1303	172
14	0.860	87400	1130	169
13	0.880	89200	961	167
12	0.900	91000	794	82
11	0.910	91900	712	82
10	0.920	92800	631	81
9	0.930	93700	550	80
8	0.940	94600	469	80
7	0.950	95500	389	79
6	0.960	96400	310	78
5	0.970	97300	232	78
4	0.980	98200	154	39
3	0.985	98650	115	39
2	0.990	99100	77	38
1	0.995	99550	38	38
0	1.000	100000	0	0

2001 EPA MM5

- Cumulus: Kain-Fritsch
- PBL: Pleim-Chang
- Moisture: Reisner 2
- Radiation: RRTM
- LSM: Pleim-Xu

2002 VISTAS

- Cumulus: Kain-Fritsch 2
- PBL: Pleim-Chang
- Moisture: Reisner 1
- Radiation: RRTM
- LSM: Pleim-Xu

2002 WRAP

- Cumulus: Kain-Fritsch 2
- PBL: Pleim-Chang
- Moisture: Reisner 2
- Radiation: RRTM
- LSM: Pleim-Xu

2003 MRPO

- Cumulus: Kain-Fritsch 2
- PBL: Pleim-Chang
- Moisture: Reisner 1
- Radiation: RRTM
- LSM: Pleim-Xu

Evaluation Products

Primary Products A

Series of Spreadsheets

Overall Statistics Plots

bias-time

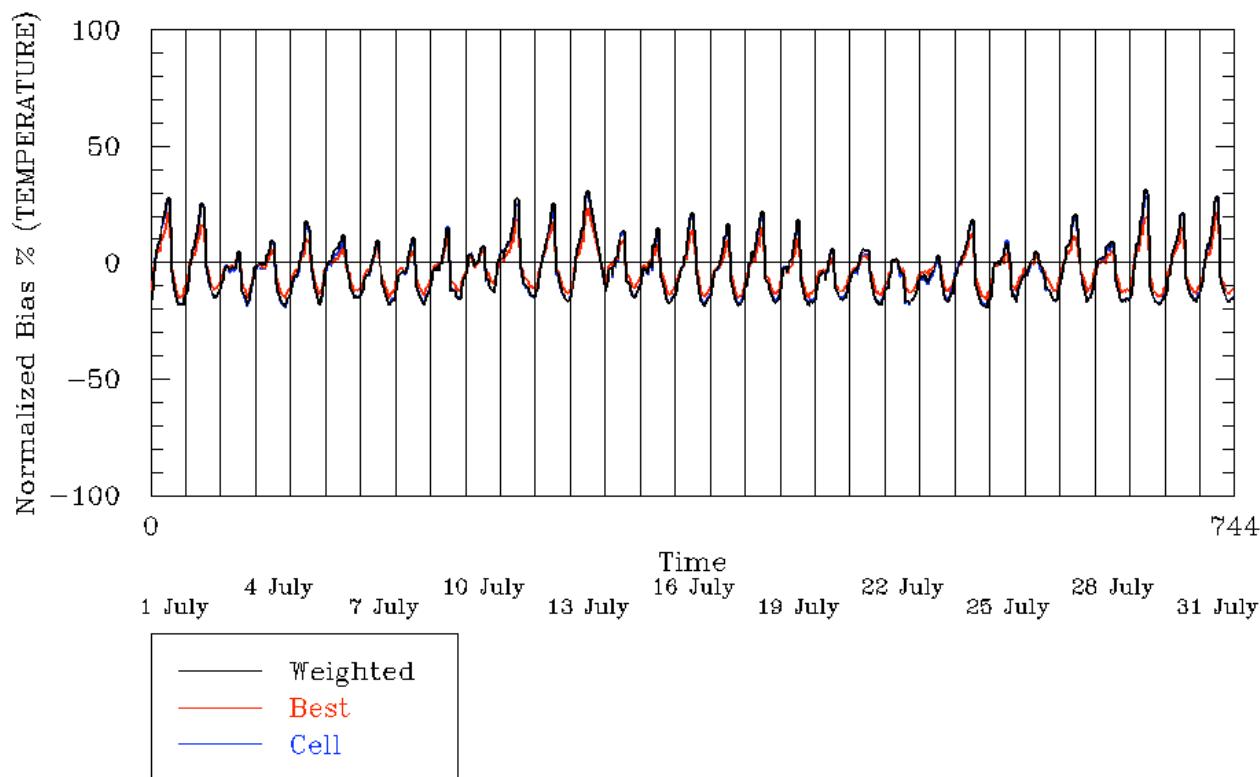
error-time

spatial mean

station time series

Sample Products (WRAP 2002)

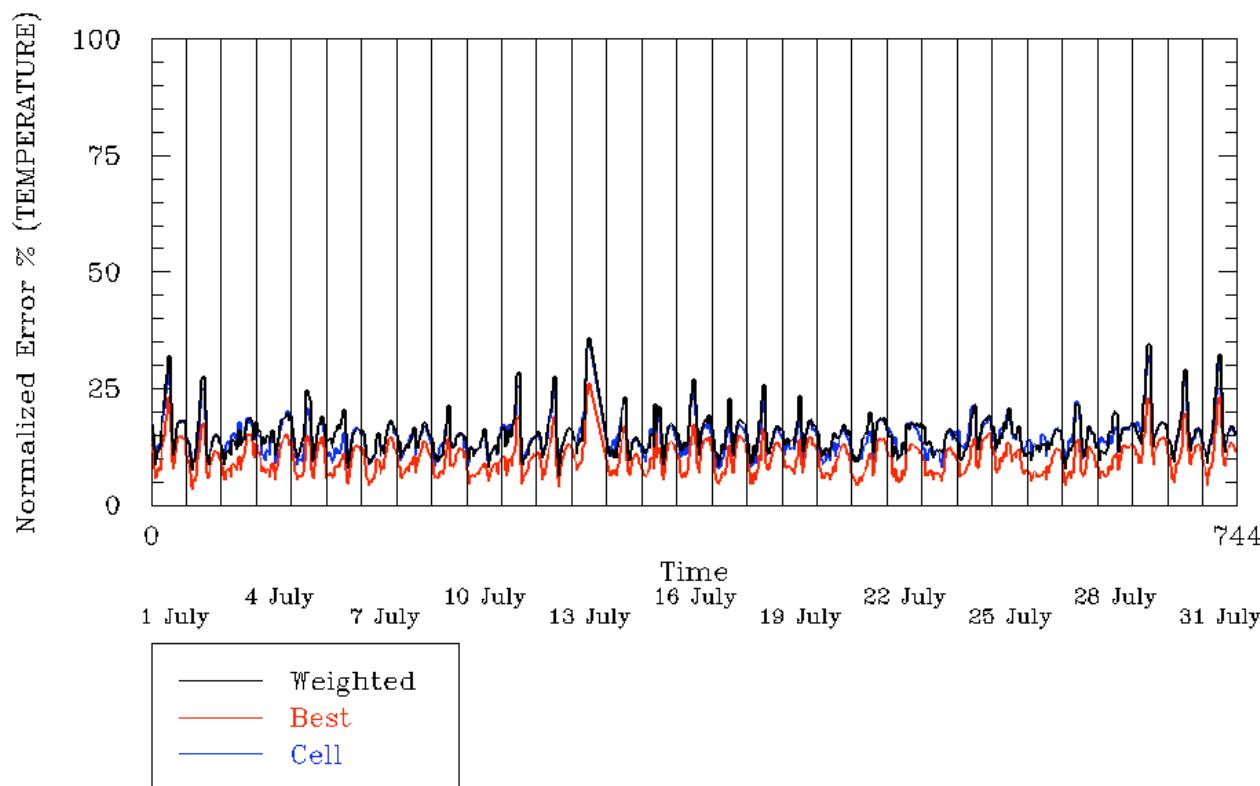
Bias Time



Normalized Bias % 36km in the CO

Sample Products

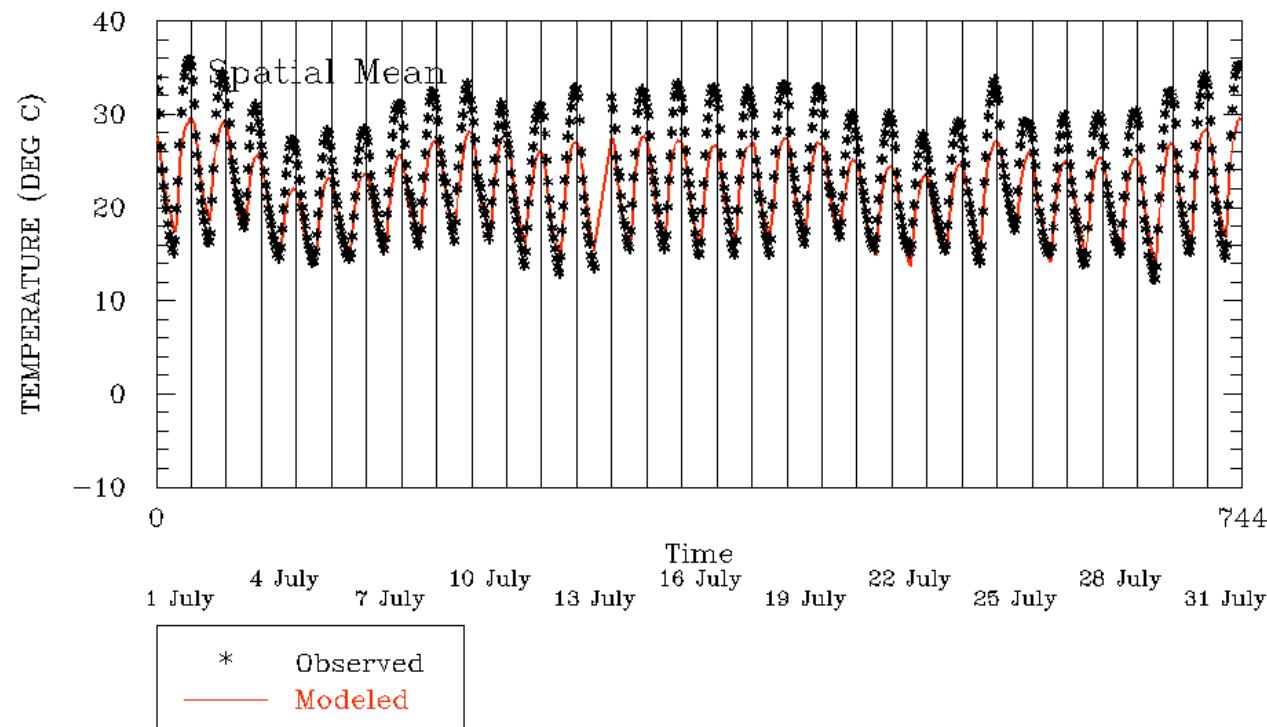
Error Time



Normalized Error % 36km in the CO

Sample Products

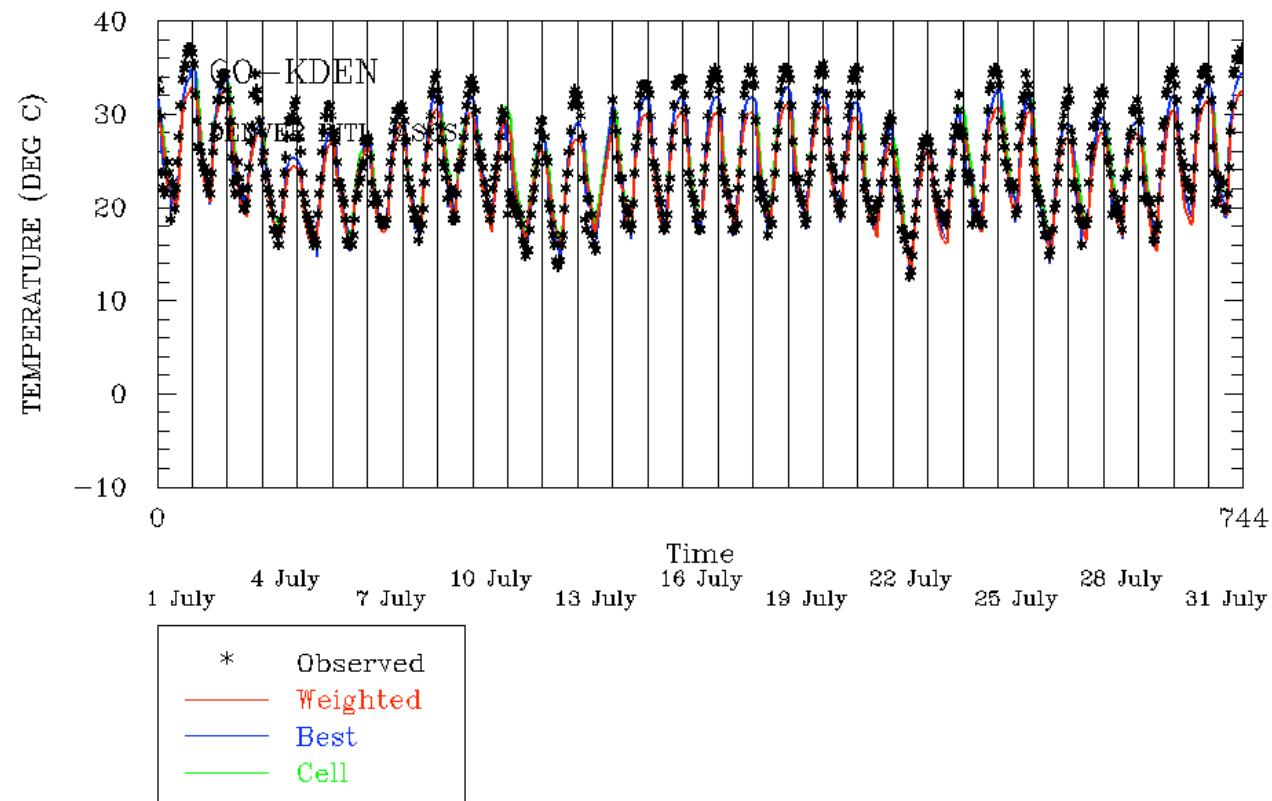
Spatial Mean



Neighborhood Spatial Mean 36km in the CO

Sample Products

Station Time Series



Spatial Time Series Comparison 36km in the CO

Summary Results

Mixing Ratio Bias (g/kg)

	ALL	CENRAP	MANE_VU	MW	VISTAS	WRAP
EPA 2001	-0.11	-0.24	-0.06	-0.22	0.06	-0.08
WRAP 2002	-0.09	-0.34	0.08	-0.11	0.20	-0.09
VISTAS 2002	0.01	-0.07	0.19	0.13	0.02	-0.04
MRPO 2003	0.22	0.11	0.30	0.29	0.49	0.05

Summary Results

Mixing Ratio Error (g/kg)

	ALL	CENRAP	MANE_VUMW		VISTAS	WRAP
EPA 2001	1.02	1.09	0.80	0.85	1.13	1.04
WRAP 2002	1.03	1.17	0.82	0.93	1.16	0.94
VISTAS 2002	0.01	0.98	0.78	0.82	1.13	0.90
MRPO 2003	0.96	0.98	0.78	0.82	1.14	0.97

Summary Results

Temperature Bias (K)

	ALL	CENRAP	MANE_VU	MW	VISTAS	WRAP
EPA 2001	-0.51	-0.26	-0.40	-0.31	-0.25	-1.10
WRAP 2002	-0.12	0.14	-0.15	-0.11	0.05	-0.49
VISTAS 2002	-0.05	-0.07	0.19	0.13	0.02	-0.04
MRPO 2003	-0.15	0.11	-0.17	-0.10	0.18	-0.67

Summary Results

Temperature Error (K)

	ALL	CENRAP	MANE_VUMW	VISTAS	WRAP
EPA 2001	2.04	1.77	1.85	1.63	1.92
WRAP 2002	2.10	1.85	1.80	1.74	1.93
VISTAS 2002	2.02	1.76	1.80	1.72	1.84
MRPO 2003	2.17	1.94	1.86	1.92	1.98

Summary Results

Wind Index of Agreement

	ALL	CENRAP	MANE_VUMW	VISTAS	WRAP
EPA 2001	0.88	0.85	0.69	0.75	0.77
WRAP 2002	0.93	0.92	0.81	0.84	0.84
VISTAS 2002	0.90	0.88	0.71	0.78	0.79
MRPO 2003	0.90	0.88	0.72	0.78	0.80

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Advanced Atmospheric Modeling